



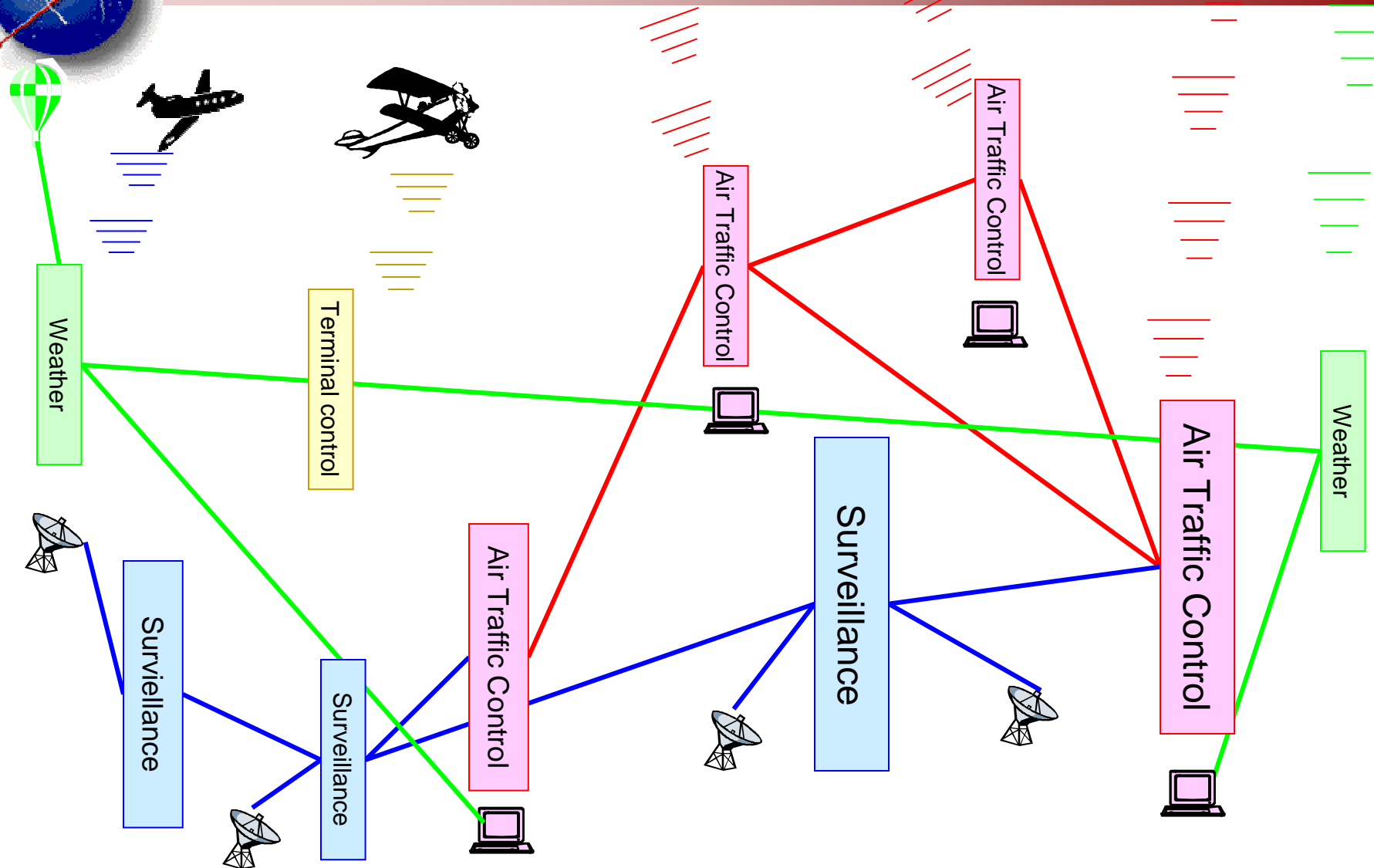
Technologies for Network-Enabled Operations

ICNS Workshop

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Current air traffic information is carried by stand-alone networks and processed by stove-pipe applications. Information interchange is special-purpose, often human-mediated, and difficult to extend.



National Airspace System (NAS) Problems Addressed with NEO

- Poor information-sharing leading to efficiency losses
- Collaborative tactical and strategic decision making
- Lack of common situational awareness, flight and weather status
- Shared traffic look-ahead between centers
- Combine sectors dynamically -- across centers



Background

Technologies for Network-Enabled Operations

SMA - Surface Movement Advisor

- 1996-7 prototype in Atlanta demonstrated operational information sharing environments, improved situational awareness

Aviation Extranet concept later influences FAA and European SWIM designs

SWIM - System-Wide Information Management

- 1997 Conceived as NAS-Wide Information System (NWIS)
- 1998 The term SWIM was introduced in Europe and picked-up by FAA
- 2002 ICAO/WMO adopted the SWIM concept
- 2002 RTCA published NAS CONOPS and Future Vision with detailed SWIM objectives

TSWIM - Technologies for SWIM

- 2002 NASA begins initial planning and advocacy, including gap analysis
- 2003 Architecture studies and limited technology proposals evaluated



Background

Technologies for Network-Enabled Operations

DoD Net-Centric Data Strategy

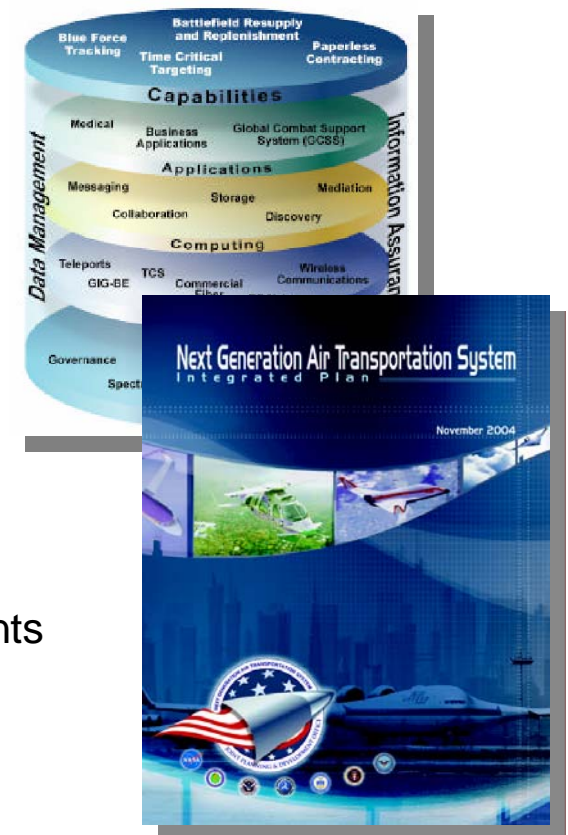
- 2001 DoD CIO memo - Interoperability and Data Management
- 2003 DoD CIO memo - Called for “Vertical Integration”
Data Management and Information Assurance within
Information Sharing Environment

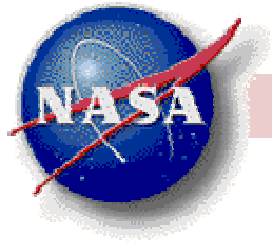
JPDO - Joint Planning and Development Office

- Oct 2004: NASA representatives assigned to JPDO
- Dec 2004: JPDO submits NGATS Plan to Congress

NEAT - Network Enabled Air/Space Transformation

- 2005 TSWIM planning updated to reflect JPDO requirements
NEAT designed to address NASA-unique requirements





Requirements

Technologies for Network-Enabled Operations

JPDO SSA IPT
(v2 27/28 January 2005)



Capabilities-Based Planning Action Plan 1

UNCLASSIFIED

National Plan Objective:

§ Enable services tailored to traveler and shipper needs



Capabilities-Based Planning Action Plan 2

UNCLASSIFIED

National Plan Objective:

§ Increase predictability and minimize impact of weather and other disruptions



Capabilities-Based Planning Action Plan 3

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National Plan Objective:

§ Coordinate a national response to threats and ensure security efficiently serves demand



Capabilities-Based Planning Action Plan 4

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National Plan Objective:

§ Provide for the common defense while minimizing civilian constraints

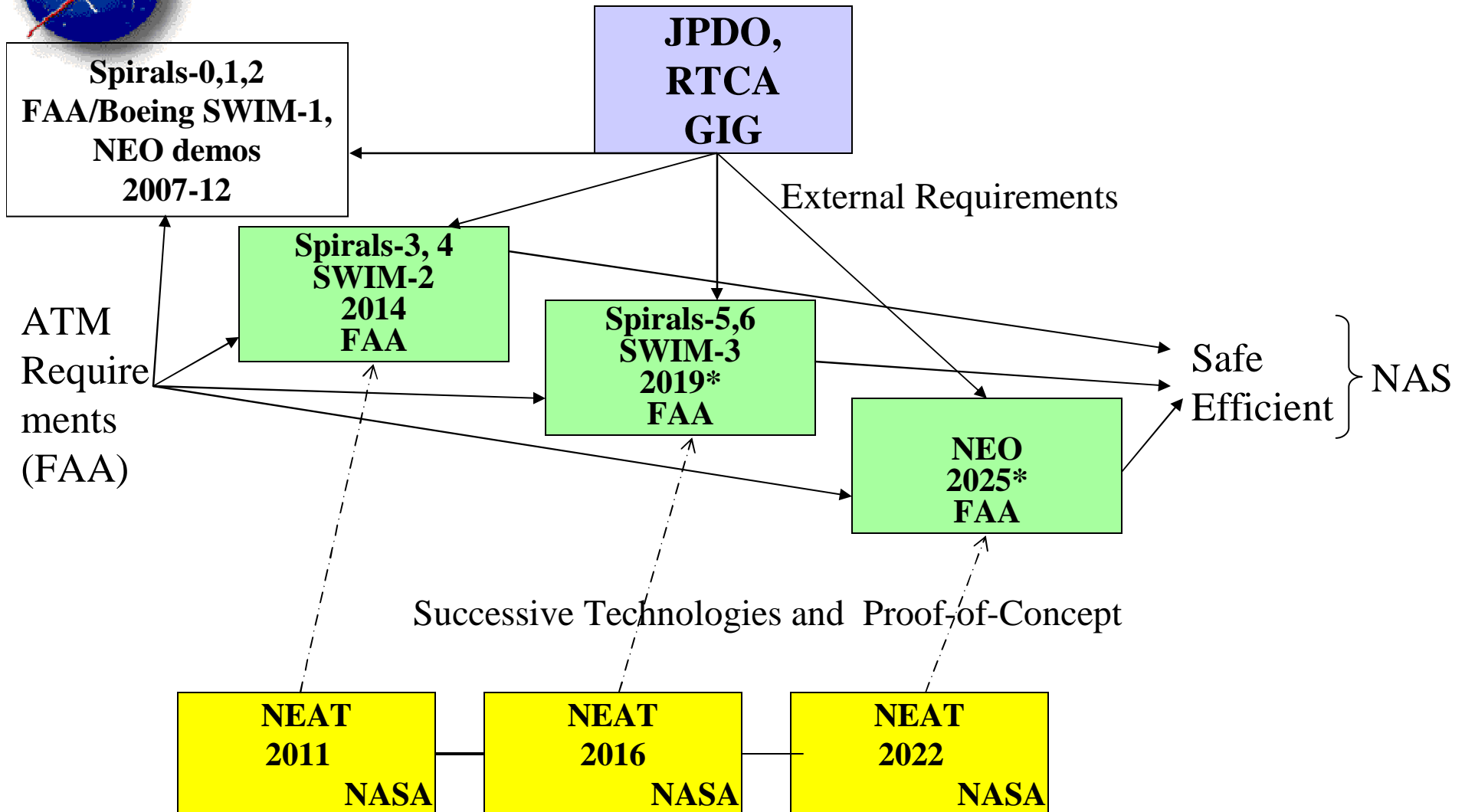
IPT Desired Outcomes:

§ SSA 4.1 Technology and processes enable HLS/HD decision makers to act on shared situational awareness to effectively deter, predict, plan for, and preempt threats to the homeland, prior to those threats transiting the air and space medium or targeting our air and space capabilities

§ SSA 4.2 Materialized air, space, and missile threats to the United States, of all types, will be detected, identified, intercepted, and neutralized using integrated, multiple agency Homeland Security and Homeland Defense systems

Drawn from national plan objectives, specified desired outcomes:

- Enable services tailored to traveler and shipper needs - Action Plan 1
- Increase predictability and minimize impact of weather and other disruptions - Action Plan 2
- Coordinate a national response to threats and Ensure security efficiently serves demand - Action Plan 3
- Provide for the common defense while minimizing civilian constraints - Action Plan 4

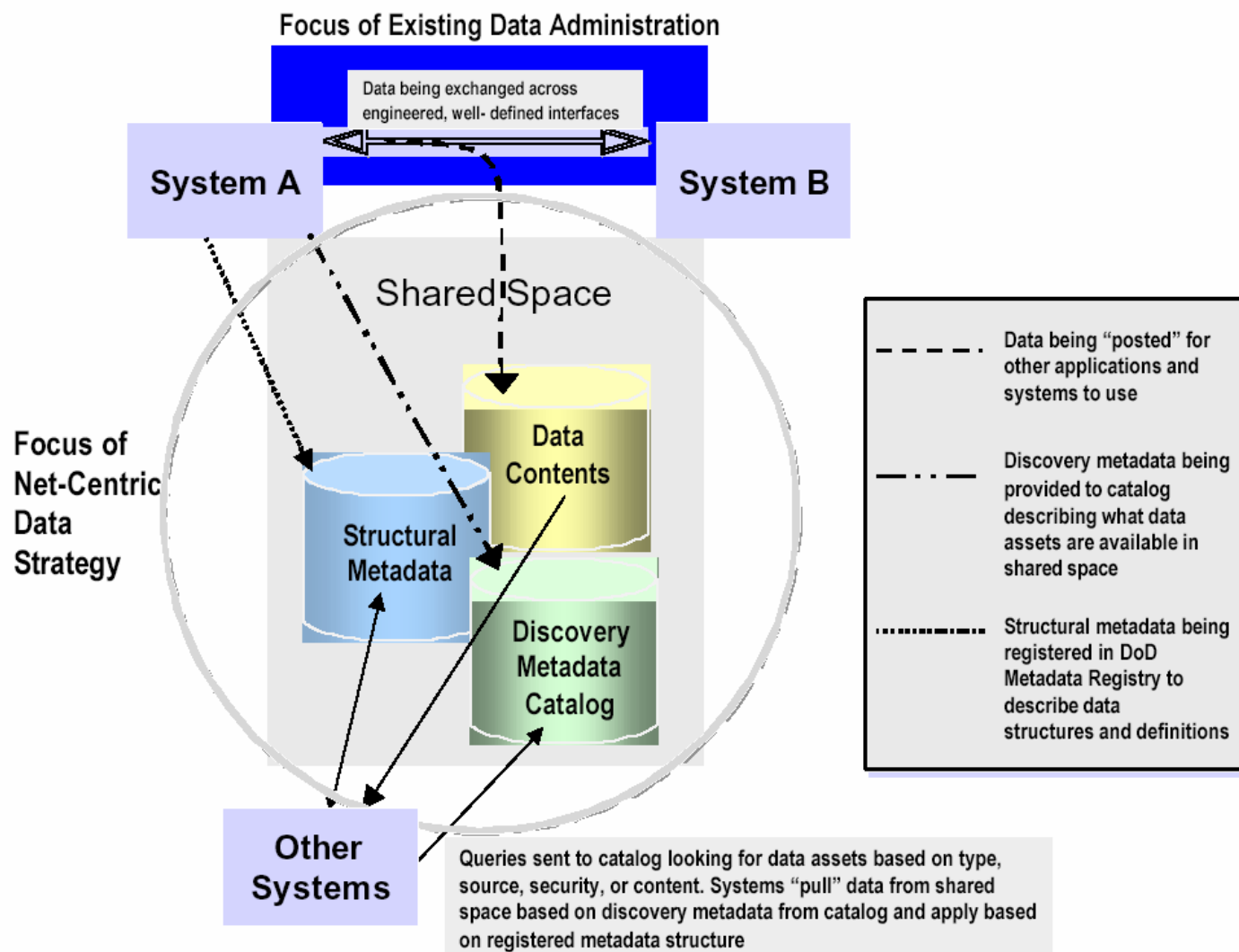


* Notional Future NAS Updates



Scope of DoD Net-Centric Data Strategy

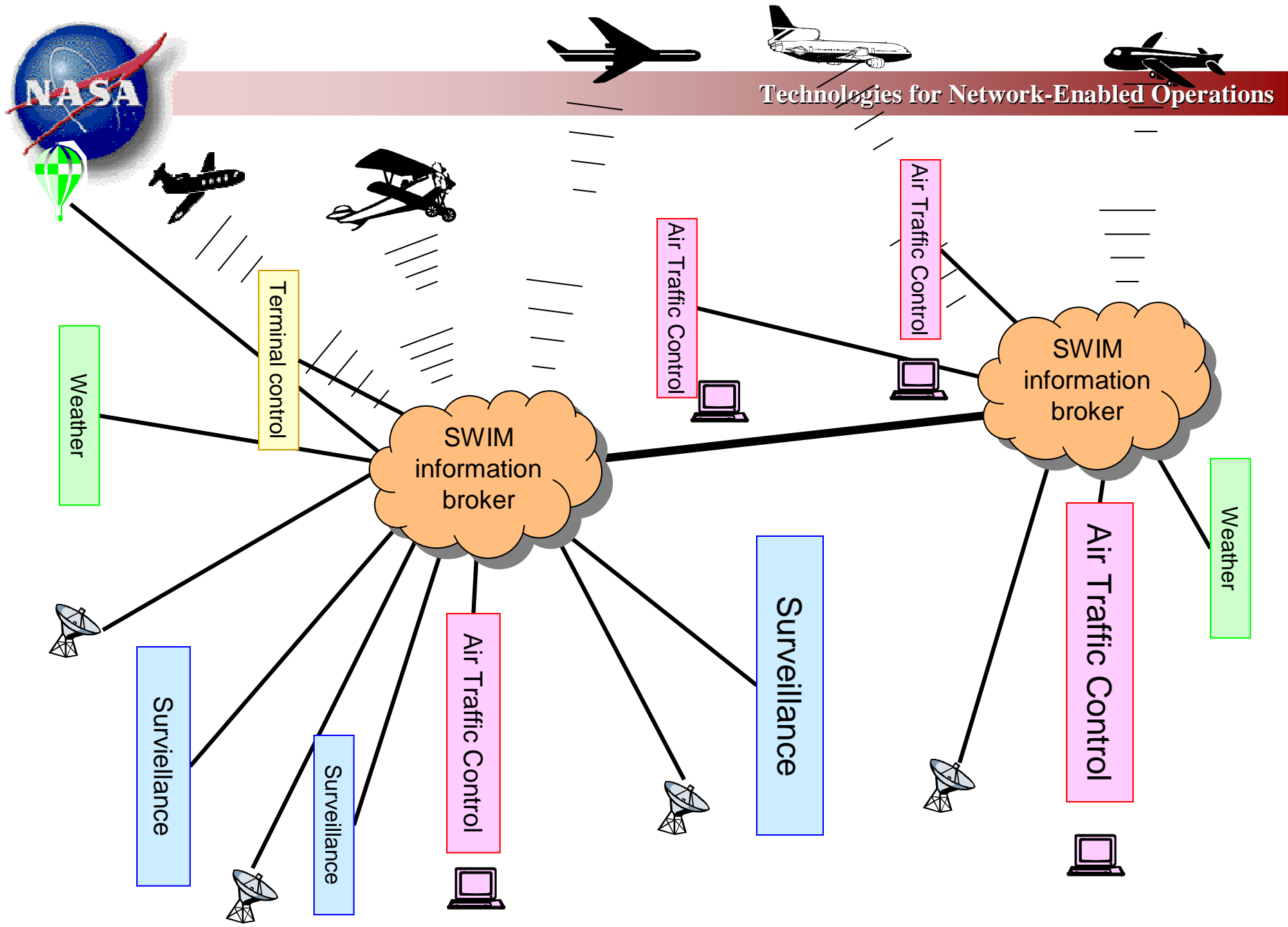
Technologies for Network-Enabled Operations





NEO Challenges

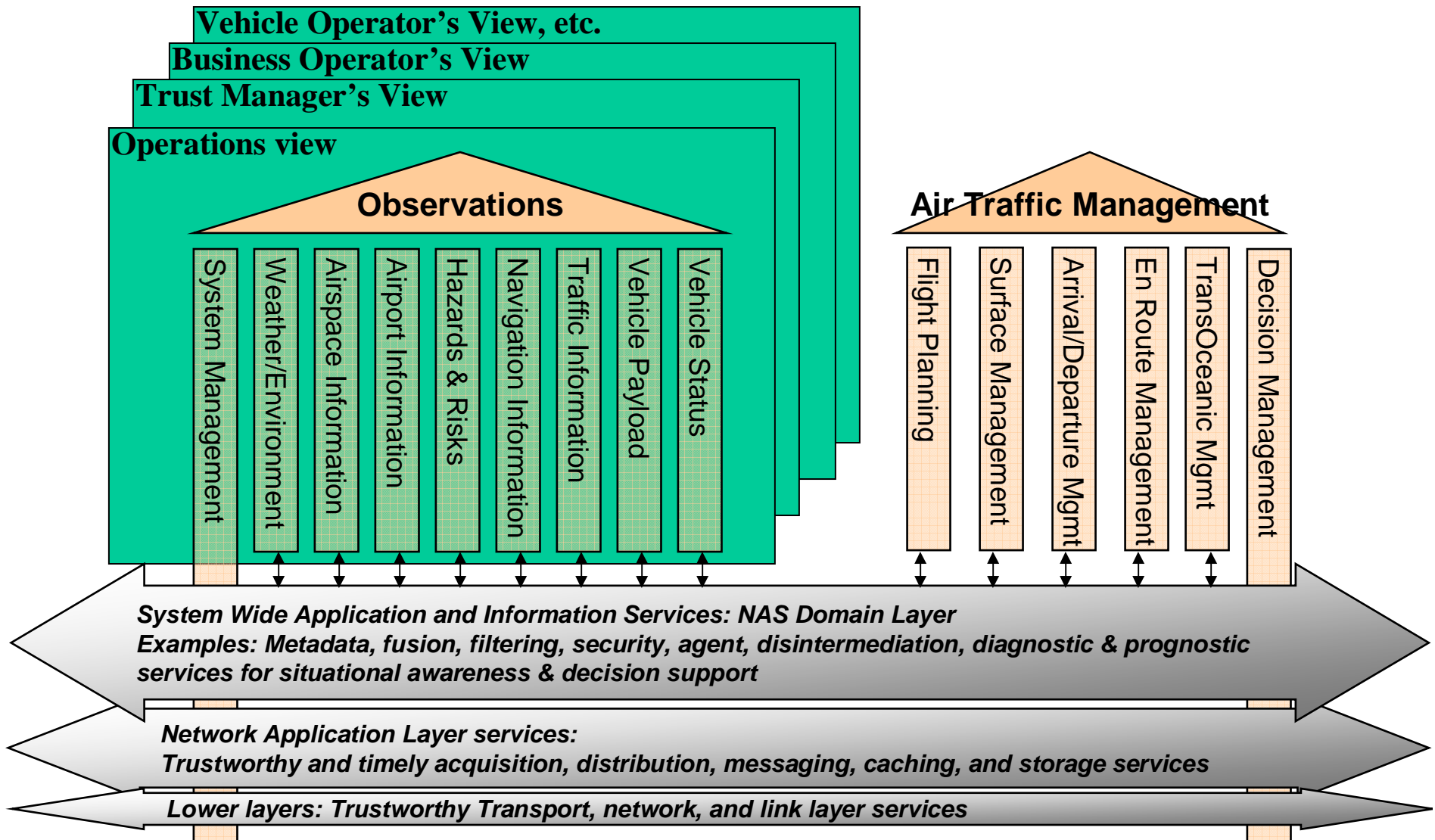
- Change from completely independent functioning systems into a distributed design architecture
- Implementation of a true integrated systems design architecture
- Integration of a scalable system-wide information management system for real-time decision-making that is extendable to accommodate future demand for air transportation
- Integrated system-level picture of the past, present, and planned state of the air transportation system to serve as a common basis for improved decision-making and a more safe and secure operation

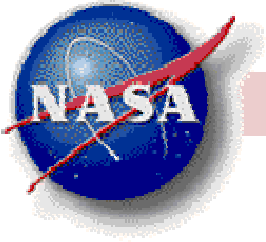


Near-term SWIM (FAA/industry) will enable uniform, pre-defined information sharing among applications on shared networks with simple subscriptions



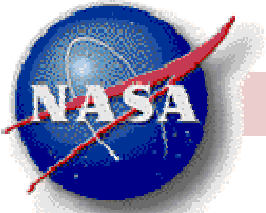
NAS Needs are bigger than just Traffic Management





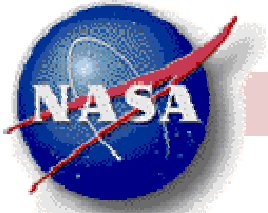
Info Sharing Gap Assessment - 2003

- Ref: RTCA NAS Concept of Operations, Version 4.3
- Considering all tech. needs beyond FAA state-of-practice in current NAS or early SWIM (Spirals 0-2)
- Focused on 2010-20 timeframe, equal to SWIM Spirals 3-5
 - Including areas best served by COTS/industry as well as Gov't R&D needs
- *Hardware*
- *Integration*
- *Communications*
- *Software*
- *Testing*



Gap Disposition - Software

Gap	Likely Approach	Relevant Project Expertise
SWIM system self-monitoring	Autonomic hardware computing technologies from industry, Network Mgt	Not addressed yet
SWIM system health management and automatic recovery	Combination of Govt and COTS; further R&D (no one is addressing as yet)	IVHM support has dwindled in vehicle systems, shifted to space science
Intelligent Agents	NASA or DoD-sponsored technologies, universities	ARC - ARA and CAS groups and surface ATC; JPL automation group APL, Boeing
Data mining	Combination of Govt and COTS	GSFC - earth sciences ARC - statistical methods Active Objects - COTS
Projection, trending, prognostics	Domain-specific, FAA and contractors	ARC - ARA group, JPL, Av. Safety L2
Database validation	Combine COTS tools with Govt. domain knowledge	Probably outsourced
Data Cleansing	New R&D	Still a research topic
Heterogeneous software environments	Grids	ARC, GRC, Harris
Anomalous data ID and compensation	Meta-data generation from large databases	Boeing, ARC, CSC



Vision, Goals, and Objectives

Technologies for Network-Enabled Operations

Network Enabled Air/Space Transformation (NEAT)

“on-demand data products, real-time services, and automated surveillance”

Vision*

Develop net-centric NAS software applications compatible/interoperable with the Global Information Grid (GIG) to meet civil capacity and safety/security demands of the future.

Goals

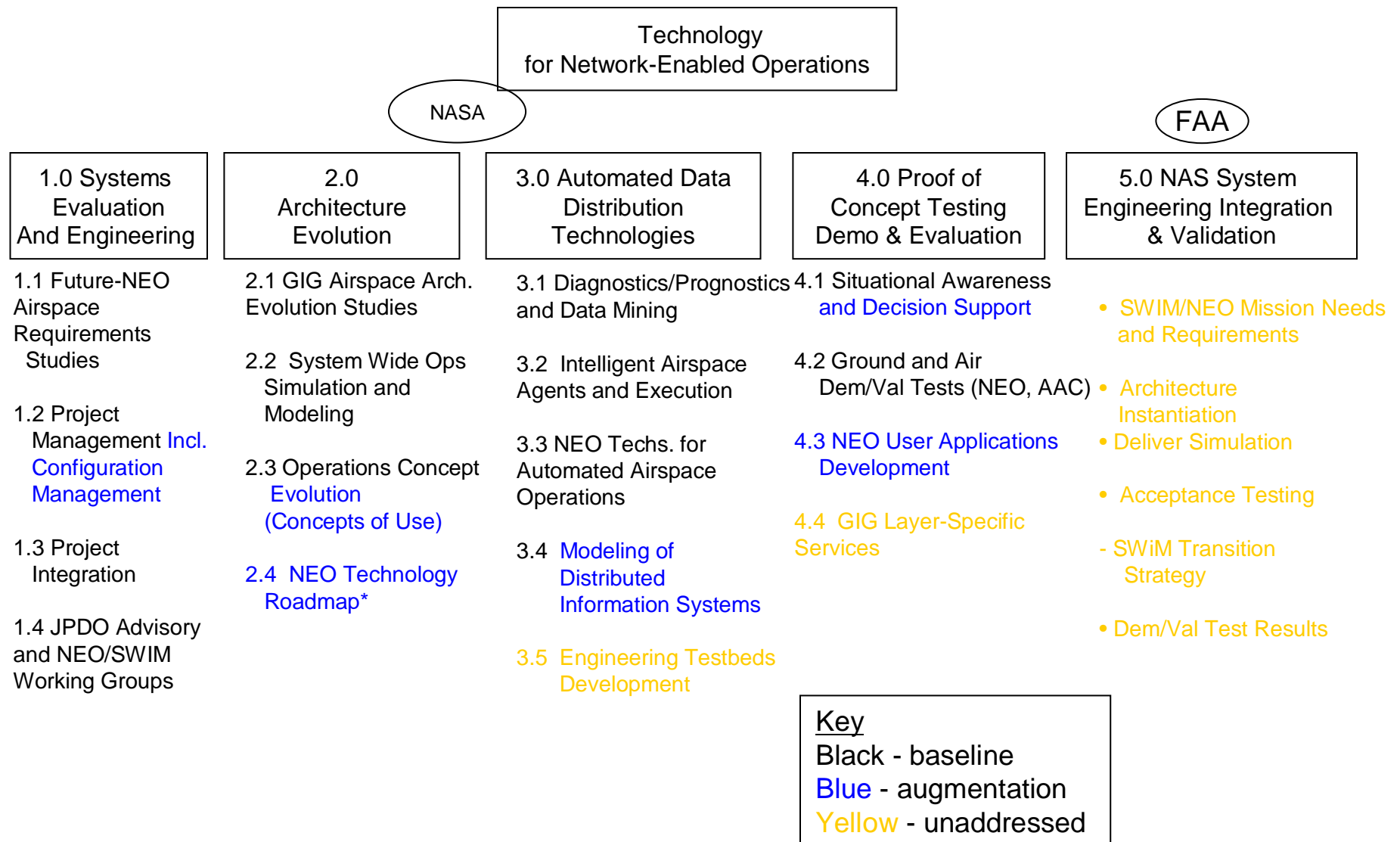
1. Demonstrate on-demand data products for modeling, simulation, and analysis
2. Demonstrate real-time network services and surveillance algorithms for advanced decision support systems

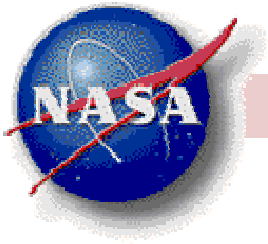
Objectives

1. Initiate network interface to the GIG for on-demand data products.
Metric: Establish an initial network interface to the GIG and a programming environment for generating automated data products
2. Automated data distribution to an advanced tactical decision support system (DSS).
Metric: 200 hr continuous “no failure” operation with a DSS (e.g. McTMA) to demonstrate “pulling” information from the GIG
3. Surveillance algorithms for automated anomaly detection and threat assessment to strategic DSS
Metric: 200 hr continuous “no failure” operation with simulated flight path deviations (e.g. from collaborative TM) to demonstrate thresholds and protocols for “posting” threats to the GIG



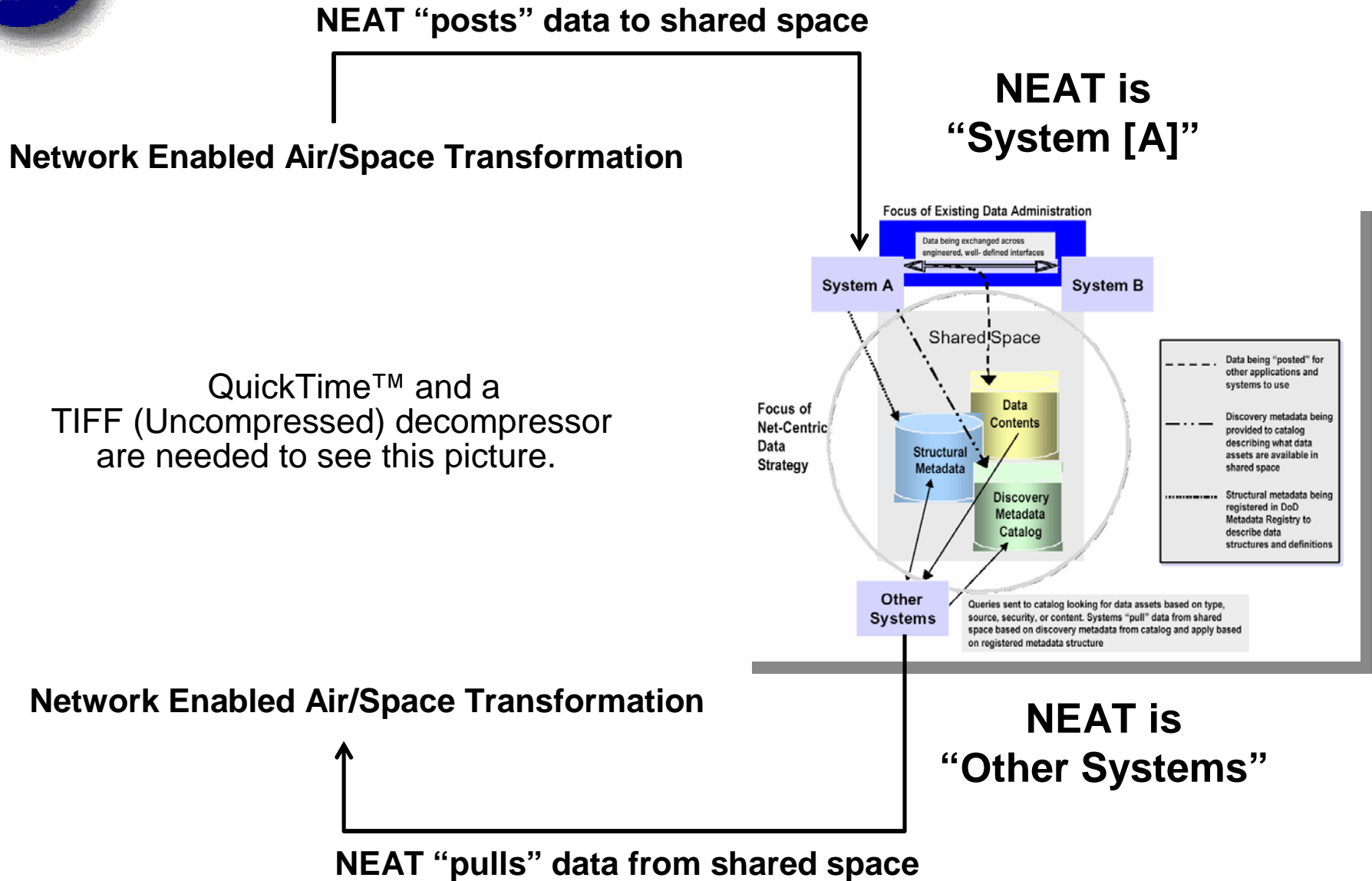
Work Breakdown Structure





TNEO Approach (NEAT)

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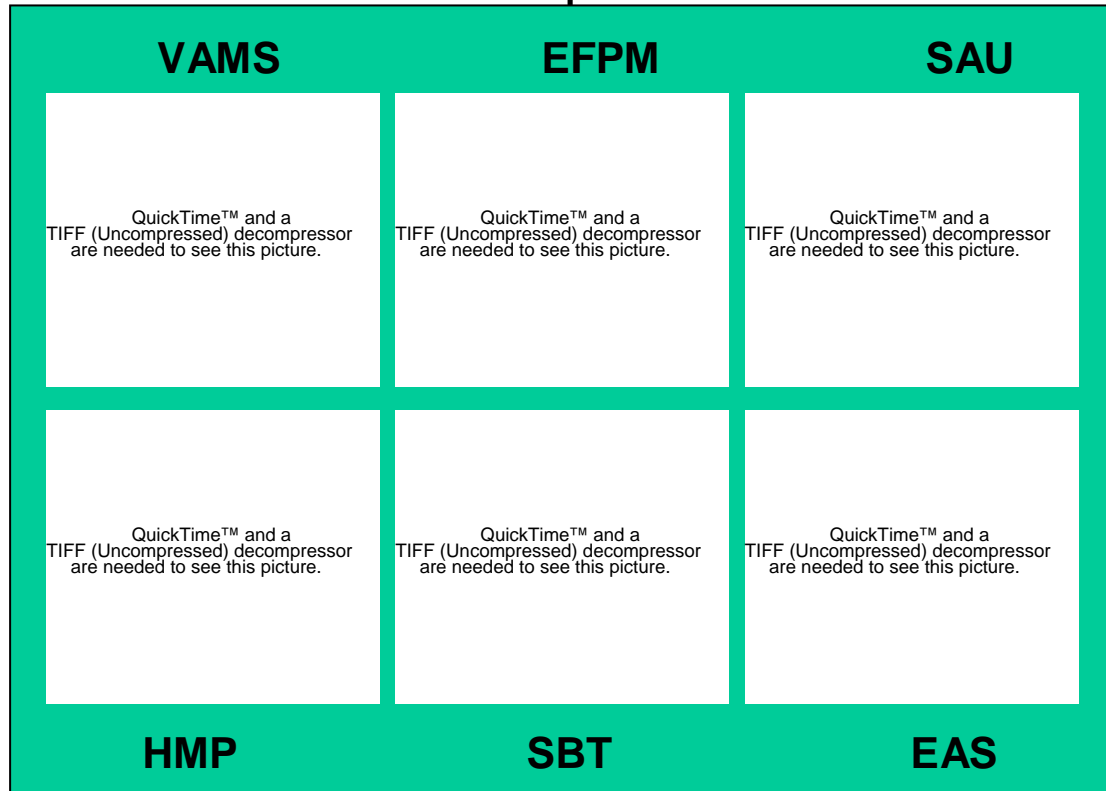


Approach (Application to Airspace Systems)

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WBS 4.0

Proof of Concept Testing
Demonstrations and Evaluations



Intelligent Agents
Data Fusion

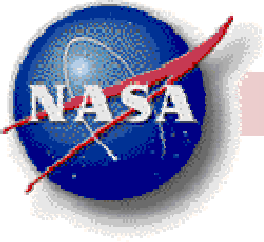
WBS 2.0

Architecture Evolution

Intelligent Agents
Data Fusion

WBS 3.0

Automated Data Distribution Technologies



Summary

- Current point-to-point data links will not scale to support future integration of surveillance, security, and globally-distributed air traffic data
 - already hinders efficiency and capacity
- FAA and industry focus on a transition to initial system-wide information management (SWIM) capabilities (Spirals 0-2)
- Off-the-shelf technologies do not fully address future NAS requirements (JPDO, RTCA, etc)
- Studies of NAS network-enabled operations technology gaps targeted for maturity in later SWIM spirals (2015-2020 timeframe)
- Uncovered areas in intelligent agents, data fusion, communications, integration of legacy NAS systems with GIG
- NEAT R&D proposed in targeted areas